

2.6 Clouds and Radiative Swath (CRS)

EOSDIS Product Code: CER04

The Clouds and Radiative Swath (CRS) product contains one hour of instantaneous Clouds and the Earth's Radiant Energy System (CERES) data for a single scanner instrument. The CRS contains all of the CERES SSF product data. For each CERES FOV on the SSF, the CRS also contains vertical flux profiles evaluated at five levels in the atmosphere: the surface, 500 hPa, 200 hPa, 70 hPa, and 1 hPa. The CRS fluxes and cloud parameters are adjusted for consistency with a radiative transfer model, and adjusted fluxes are evaluated at the five atmospheric levels for both clear-sky and total-sky.

The CRS contains the following constrained vertical flux profiles for both clear sky and total sky conditions evaluated at the surface, 500 hPa, 200 hPa, 70 hPa, and 1 hPa, along with pristine fluxes at the surface and 1 hPa:

- Longwave upward and downward.
- Shortwave upward and downward.
- Window channel upward and downward.

The initial flux profiles are not contained on the CRS; however, the adjustments between the constrained and initial profiles for the following are included for clear sky, total sky, and pristine conditions:

- Longwave upward at the surface and 1 hPa, and downward at the surface.
- Shortwave upward at the surface and 1 hPa, and downward at the surface.
- Window channel upward at the surface and 1 hPa, and downward at the surface.

The adjustments to the radiative transfer model input parameters between the initial and the constrained passes are also contained on the CRS. These parameters include:

- Surface albedo and skin temperature.
- Total column precipitable water and upper tropospheric relative humidity.
- Aerosol optical depth.
- Cloud optical depth, fractional area, and effective temperature.

Level: 2

Frequency: 1/ Hour

Configuration Code: 008007 and greater

Time Interval Covered

File: 1 Hour

Record: 1/100-Second

Portion of Globe Covered

File: Satellite Swath

Record: 1 CERES FOV

Portion of Atmosphere Covered

File: Surface to 1 hPa

CRS Metadata

The types of CRS metadata are summarized in [Table 2.6-1](#) and contain information which need only be recorded once per hour. The CERES metadata are listed in [Appendix B](#). [Table B-1](#) lists the CERES Baseline Header Metadata and [Table B-2](#) lists the parameters in the CERES_metadata Vdata Table. Note that the CERES_metadata Vdata is a subset of the CERES Baseline Header Metadata. The CRS product-specific metadata parameters are listed in [Table 2.6-1](#) and the CRS_Header_Vdata parameters are listed in [Table 2.6-2](#).

Table 2.6-1. CRS Metadata Summary

HDF Name	Description Table	Records	Number of Fields
CERES Baseline Header Metadata	Table B-1	1	36
CERES_metadata Vdata	Table B-2	1	14
CRS Product-specific Metadata	Table 2.6-2	1	3
CRS_Header Vdata	Table 2.6-2	1	25

Table 2.6-2. CRS_Header_Vdata

Item	Description	Units	Range	Elements	Bytes/Elem
CRS-H1	SSF ID	N/A	112 .. 200	1	4
CRS-H2	Character name of CERES instrument	N/A	ASCII string	1	4
CRS-H3	Day and Time at hour start	N/A	ASCII string	1	28
CRS-H4	Character name of satellite	N/A	ASCII string	1	4
CRS-H5	Character name of high resolution imager instrument	N/A	ASCII string	1	8
CRS-H6	Number of imager channels	N/A	1 .. 20	1	4
CRS-H7	Central wavelengths of imager channels	μm	0.4 .. 15.0	20	4
CRS-H8	Earth-Sun distance at hour start	AU	0.98 .. 1.02	1	4
CRS-H9	Beta Angle	deg	-90 .. 90	1	4
CRS-H10	Colatitude of subsatellite point at surface at hour start	deg	0 .. 180	1	4
CRS-H11	Longitude of subsatellite point at surface at hour start	deg	0 .. 360	1	4
CRS-H12	Colatitude of subsatellite point at surface at hour end	deg	0 .. 180	1	4
CRS-H13	Longitude of subsatellite point at surface at hour end	deg	0 .. 360	1	4
CRS-H14	Along-track angle of satellite at hour end	deg	0 .. 330	1	4
CRS-H15	Number of Footprints in SSF product	N/A	0 .. 360000	1	4
CRS-H16	Subsystem 4.1 identification string	N/A	ASCII string	1	128
CRS-H17	Subsystem 4.2 identification string	N/A	ASCII string	1	128
CRS-H18	Subsystem 4.3 identification string	N/A	ASCII string	1	128
CRS-H19	Subsystem 4.4 identification string	N/A	ASCII string	1	128
CRS-H20	Subsystem 4.5 identification string	N/A	ASCII string	1	128
CRS-H21	Subsystem 4.6 identification string	N/A	ASCII string	1	128
CRS-H22	IES production date and time	N/A	ASCII string	1	24
CRS-H23	MOA production date and time	N/A	ASCII string	1	24
CRS-H24	SSF production date and time	N/A	ASCII string	1	24
CRS-H25	Instantaneous SARB Version number	N/A	1 .. 26	1	2
CRS-H26	CRS production date and time	N/A	ASCII string	1	19

CRS Scientific Data Sets

The CRS contains 206 Scientific Data Sets (SDS) which are parameter collections of along-track ordered FOVs where the first dimension corresponds to the number of FOVs; the last dimension corresponds to the number of parameters; and the middle dimension, if rank 3, corresponds to the number of elements in each parameter array. This ordering is used by the C programming language and most HDF viewers. In Fortran, the dimensions are reversed such that the number of FOVs becomes the last dimension and the first dimension is the number of parameters in the SDS. The first 131 SDSs are also contained on the SSF. (For a list of the first 131 SDSs, see [Table 2.5-3](#) through [Table 2.5-13](#).) The SDSs are divided into tables which map to Vgroups of the same name. Table 0.0-3 to Table 0.0-12 summarize the contents of each Vgroup and SDS contained within the CRS file. Product sizing information for the maximum number of possible FOVs is given in Table 2.6-16. (Note: the dimension n in the following tables is the number of FOVs processed: Assuming $n = 245475$ for sizing).

Table 2.6-3. Surface Radiative Properties

Item	SDS Name	Units	Range	Dimensions	Data Type	Maximum Hourly Size (MB)
CRS-132	Photosynthetically active radiation over surface (TBD)	$W m^{-2}$	0 .. 780	n	32 bit real	0.94
CRS-133	Direct/diffuse surface ratio	N/A	0 .. 30	n	32 bit real	0.94
CRS-134	Corrected initial broadband surface albedo	N/A	0 .. 1	n	32 bit real	0.94

Table 2.6-4. Vertical Profile Description

Item	SDS Name	Units	Range	Dimensions	Data Type	Maximum Hourly Size (MB)
CRS-135	Number of atmospheric levels	N/A	0 .. 5	n	32 bit integer	0.94
CRS-136	Pressure levels	hPa	0 .. 1100	n x 5	32 bit real	4.68

Table 2.6-5. Pristine Vertical Flux Profiles

Item	SDS Name	Units	Range	Dimensions	Data Type	Maximum Hourly Size (MB)
CRS-137	SW flux - upward - pristine	$W m^{-2}$	0 .. 1400	n x 2	32 bit real	1.87
CRS-138	SW flux - downward - pristine	$W m^{-2}$	0 .. 1400	n x 2	32 bit real	1.87
CRS-139	LW flux - upward - pristine	$W m^{-2}$	0 .. 850	n x 2	32 bit real	1.87
CRS-140	LW flux - downward - pristine	$W m^{-2}$	0 .. 700	n x 2	32 bit real	1.87
CRS-141	WN flux - upward - pristine	$W m^{-2}$	0 .. 370	n x 2	32 bit real	1.87
CRS-142	WN flux - downward - pristine	$W m^{-2}$	0 .. 370	n x 2	32 bit real	1.87

Table 2.6-6. Constrained Clear Sky Profiles

Item	SDS Name	Units	Range	Dimensions	Data Type	Maximum Hourly Size (MB)
CRS-143	SW flux - upward for clear-sky	W m ⁻²	0 .. 1400	n x 5	32 bit real	4.68
CRS-144	SW flux - downward for clear-sky	W m ⁻²	0 .. 1400	n x 5	32 bit real	4.68
CRS-145	LW flux - upward for clear-sky	W m ⁻²	0 .. 850	n x 5	32 bit real	4.68
CRS-146	LW flux - downward for clear-sky	W m ⁻²	0 .. 700	n x 5	32 bit real	4.68
CRS-147	WN flux - upward for clear-sky	W m ⁻²	0 .. 370	n x 5	32 bit real	4.68
CRS-148	WN flux - downward for clear-sky	W m ⁻²	0 .. 370	n x 5	32 bit real	4.68

Table 2.6-7. Constrained Total Sky Profiles

Item	SDS Name	Units	Range	Dimensions	Data Type	Maximum Hourly Size (MB)
CRS-149	SW flux - upward for total-sky	W m ⁻²	0 .. 1400	n x 5	32 bit real	4.68
CRS-150	SW flux - downward for total-sky	W m ⁻²	0 .. 1400	n x 5	32 bit real	4.68
CRS-151	LW flux - upward for total-sky	W m ⁻²	0 .. 850	n x 5	32 bit real	4.68
CRS-152	LW flux - downward for total-sky	W m ⁻²	0 .. 700	n x 5	32 bit real	4.68
CRS-153	WN flux - upward for total-sky	W m ⁻²	0 .. 370	n x 5	32 bit real	4.68
CRS-154	WN flux - downward for total-sky	W m ⁻²	0 .. 370	n x 5	32 bit real	4.68

Table 2.6-8. Pristine Constraint-Initial Flux Deltas

Item	SDS Name	Units	Range	Dimensions	Data Type	Maximum Hourly Size (MB)
CRS-155	SW flux adjustment at surface - upward - pristine	W m ⁻²	-1400 .. 1400	n	32 bit real	0.94
CRS-156	SW flux adjustment at TOA - upward - pristine	W m ⁻²	-1400 .. 1400	n	32 bit real	0.94
CRS-157	SW flux adjustment at surface - downward - pristine	W m ⁻²	-1400 .. 1400	n	32 bit real	0.94
CRS-158	LW flux adjustment at surface - upward - pristine	W m ⁻²	-600 .. 600	n	32 bit real	0.94
CRS-159	LW flux adjustment at surface - downward - pristine	W m ⁻²	-700 .. 700	n	32 bit real	0.94
CRS-160	LW flux adjustment at TOA - upward - pristine	W m ⁻²	-700 .. 700	n	32 bit real	0.94
CRS-161	WN flux adjustment at surface - upward - pristine	W m ⁻²	-50 .. 50	n	32 bit real	0.94
CRS-162	WN flux adjustment at surface - downward - pristine	W m ⁻²	-50 .. 50	n	32 bit real	0.94
CRS-163	WN flux adjustment at TOA - upward - pristine	W m ⁻²	-50 .. 50	n	32 bit real	0.94

Table 2.6-9. Clear Sky Constraint-Initial Flux Deltas (1 of 2)

Item	SDS Name	Units	Range	Dimensions	Data Type	Maximum Hourly Size (MB)
CRS-164	SW flux adjustment at surface - upward for clear-sky	W m ⁻²	-1400 .. 1400	n	32 bit real	0.94
CRS-165	SW flux adjustment at TOA - upward for clear-sky	W m ⁻²	-1400 .. 1400	n	32 bit real	0.94

Table 2.6-9. Clear Sky Constraint-Initial Flux Deltas (2 of 2)

Item	SDS Name	Units	Range	Dimensions	Data Type	Maximum Hourly Size (MB)
CRS-166	SW flux adjustment at surface - downward for clear-sky	W m ⁻²	-1400 .. 1400	n	32 bit real	0.94
CRS-167	LW flux adjustment at surface - upward for clear-sky	W m ⁻²	-600 .. 600	n	32 bit real	0.94
CRS-168	LW flux adjustment at surface - downward for clear-sky	W m ⁻²	-700 .. 700	n	32 bit real	0.94
CRS-169	LW flux adjustment at TOA - upward for clear-sky	W m ⁻²	-700 .. 700	n	32 bit real	0.94
CRS-170	WN flux adjustment at surface - upward for clear-sky	W m ⁻²	-50 .. 50	n	32 bit real	0.94
CRS-171	WN flux adjustment at surface - downward for clear-sky	W m ⁻²	-50 .. 50	n	32 bit real	0.94
CRS-172	WN flux adjustment at TOA - upward for clear-sky	W m ⁻²	-50 .. 50	n	32 bit real	0.94

Table 2.6-10. Total Sky Constraint-Initial Flux Deltas

Item	SDS Name	Units	Range	Dimensions	Data Type	Maximum Hourly Size (MB)
CRS-173	SW flux adjustment at surface - upward for total-sky	W m ⁻²	-1400 .. 1400	n	32 bit real	0.94
CRS-174	SW flux adjustment at TOA - upward for total-sky	W m ⁻²	-1400 .. 1400	n	32 bit real	0.94
CRS-175	SW flux adjustment at surface - downward for total-sky	W m ⁻²	-1400 .. 1400	n	32 bit real	0.94
CRS-176	LW flux adjustment at surface - upward for total-sky	W m ⁻²	-600 .. 600	n	32 bit real	0.94
CRS-177	LW flux adjustment at surface - downward for total-sky	W m ⁻²	-700 .. 700	n	32 bit real	0.94
CRS-178	LW flux adjustment at TOA - upward for total-sky	W m ⁻²	-700 .. 700	n	32 bit real	0.94
CRS-179	WN flux adjustment at surface - upward for total-sky	W m ⁻²	-50 .. 50	n	32 bit real	0.94
CRS-180	WN flux adjustment at surface - downward for total-sky	W m ⁻²	-50 .. 50	n	32 bit real	0.94
CRS-181	WN flux adjustment at TOA - upward for total-sky	W m ⁻²	-50 .. 50	n	32 bit real	0.94

Table 2.6-11. Satellite Emulated Window Channel

Item	SDS Name	Units	Range	Dimensions	Data Type	Maximum Hourly Size (MB)
CRS-182	WN filtered radiance -satellite emulated	W m ⁻² sr ⁻¹	0 .. 50	n	32 bit real	0.94
CRS-183	WN filtered radiance adjustment-satellite emulated	W m ⁻² sr ⁻¹	0 .. 50	n	32 bit real	0.94
CRS-184	WN flux - satellite emulated - TOA	W m ⁻²	2 .. 50	n	32 bit real	0.94
CRS-185	WN flux adjustment - satellite emulated - TOA	W m ⁻²	2 .. 50	n	32 bit real	0.94

Table 2.6-12. Unfiltered Total Longwave

Item	SDS Name	Units	Range	Dimensions	Data Type	Maximum Hourly Size (MB)
CRS-186	Total LW unfiltered radiance - satellite emulated	W m ⁻² sr ⁻¹	0 .. 200	n	32 bit real	0.94
CRS-187	Total LW unfiltered radiance adjustment - satellite emulated	W m ⁻² sr ⁻¹	0 .. 200	n	32 bit real	0.94

Table 2.6-13. Constraint Adjustments

Item	SDS Name	Units	Range	Dimensions	Data Type	Maximum Hourly Size (MB)
CRS-188	Total column precipitable water - initial	cm	0 .. 10	n	32 bit real	0.94
CRS-189	Total column precipitable water - adjustment	cm	-10 .. 10	n	32 bit real	0.94
CRS-190	Upper tropospheric precipitable water - initial	cm	0 .. 10	n	32 bit real	0.94
CRS-191	Upper tropospheric precipitable water - adjustment	cm	-10 .. 10	n	32 bit real	0.94
CRS-192	Upper tropospheric humidity - initial	N/A	0.0 .. 100.0	n	32 bit real	0.94
CRS-193	Upper tropospheric humidity - adjustment	N/A	0.0 .. 100.0	n	32 bit real	0.94
CRS-194	Surface albedo - adjustment	N/A	-1 .. 1	n	32 bit real	0.94
CRS-195	Aerosol optical depth - initial	N/A	0 .. 2	n	32 bit real	0.94
CRS-196	Aerosol optical depth - adjustment	N/A	-2 .. 2	n	32 bit real	0.94
CRS-197	Skin temperature - initial	K	TBD	n	32 bit real	0.94
CRS-198	Skin temperature - adjustment	K	TBD	n	32 bit real	0.94
CRS-199	Mean visible optical depth- adjustment	N/A	-400 .. 400	n x 2	32 bit real	1.87
CRS-200	Mean cloud fractional area - adjustment	N/A	-1 .. 1	n x 2	32 bit real	1.87
CRS-201	Mean cloud effective temperature - adjustment	K	TBD	n x 2	32 bit real	1.87

Table 2.6-14. Aerosol Constituency Information

Item	SDS Name	Units	Range	Dimensions	Data Type	Maximum Hourly Size (MB)
CRS-202	Aerosol constituency flags	N/A	01000000 .. 18999999	n x 7	32 bit integer	6.55
CRS-203	Aerosol and surface albedo sources flag	N/A	100 - 303	n	32 bit integer	0.94

Table 2.6-15. Constraint Status

Item	SDS Name	Units	Range	Dimensions	Data Type	Maximum Hourly Size (MB)
CRS-204	Number of tuning iterations	N/A	0 .. 1	n	32 bit integer	0.94
CRS-205	Constraint status flag	N/A	0 .. 600	n	32 bit integer	0.94
CRS-206	Sigma table version number	N/A	1 .. 20	n	32 bit integer	0.94

Table 2.6-16. Sizing Information

HOURLY SSF SDS TOTAL SIZE (MAXIMUM)	260.27 MB
HOURLY CRS-ONLY SDS SIZE (MAXIMUM)	132.97MB
HOURLY CRS TOTAL SDS SIZE (MAXIMUM)	490.43 MB
DAILY CRS TOTAL SIZE (MAXIMUM)	9.15 GB